

CLAIMS

1. System for detecting individuals (8) or objects in a plurality of delimited spaces (10) each having at least one entrance (6), the detection system comprising, for each of the said delimited spaces :

5 - low frequency transmission means (4, 4*, 5, 5*) associated with the delimited space (10) and located at the said entrance (6) to transmit at least one low frequency electromagnetic signal (A, B) in a communication region (61, 62, 63, 64) substantially covering the said entrance (6); and

10 - high frequency transmission-reception means (12, 13) associated with the delimited space (10) for receiving and transmitting at least one high frequency electromagnetic signal (C, ACK),

the detection system further comprising:

15 - cards or portable electronic units (36), each equipping an individual (8) or object, each electronic unit (36) comprising a low frequency reception module (28, 46) for receiving the said low frequency electromagnetic signal (A, B) and a high frequency transmission-reception module (38, 48) for transmitting and receiving the said high frequency electromagnetic signal (C, ACK); and

20 - at least one central processing unit (20) associated with the said delimited spaces (10) and connected to the said low frequency transmission means (4, 4*, 5, 5*) as well as to the said high frequency transmission-reception means (12, 13) for recording data relative to the entrance and exit of the said portable electronic units (36),

characterized in that the system is configured to operate according to at least two distinct modes of operation (BIBO, WIWO) and in that the said low frequency electromagnetic signal (A, B) comprises selection information (SELECT, SELECT_BIBO, SELECT_WIWO) indicating which of the said at least two modes of operation (BIBO, WIWO) should be utilised by the said electronic units (36) during their passage through an entrance (6) of any one of the said plurality of delimited spaces (10).

2. System according to claim 1, characterized in that it is configured to pass, at least temporarily, from one mode of operation to another in at least one selected delimited space (10) among the said plurality of delimited spaces.

3. System according to claim 1 or 2, characterized in that the said low frequency transmission means comprise first (4, 4*) and second (5, 5*) low frequency

transmitters for transmitting first (A) and second (B) low frequency electromagnetic signals respectively carrying data relating to the delimited space (10), these first and second low frequency electromagnetic signals (A, B) being respectively transmitted in first (60, 61) and second (62, 63) communication regions, spatially separated from one another and at least partially overlapping, the said first and second communication regions (60, 61, 62, 63) being situated respectively towards the outside and towards the inside of the said delimited space (10),

in that each electronic unit (36) comprises detection means for determining the direction of passage (DIRECTION) of the said electronic unit (36) through the said entrance (6) as a function of the reception of the said first and second low frequency electromagnetic signals (A, B),

in that the system is configured to operate according to a first mode of operation (BIBO) according to which each electronic unit (36) proceeds to transmit, at least once, the said high frequency electromagnetic signal (C), the presence or absence of an electronic unit (36) in the delimited space (10) being determined on the basis of reception, by the said high frequency transmission-reception means (12, 13) of the high frequency electromagnetic signal (C) emanating from this electronic unit (36),

and in that the system is configured to function according to a second mode of operation (WIWO) according to which each electronic unit (36) proceeds to detect the said direction of passage (DIRECTION) and transmits, by means of the said high frequency electromagnetic signal (C), information relative to the said direction of passage (DIRECTION), the presence or absence of an electronic unit (36) in the said delimited space (10) being determined on the basis of the said information of the direction of passage (DIRECTION).

4. System according to claim 3, configured to pass, at least temporarily, from one mode of operation to another in at least one selected delimited space (10) among the said plurality of delimited spaces, characterized in that the said first and/or second low frequency electromagnetic signal (A, B) comprises selection information (SELECT_WIWO) determined such that the presence or absence of an electronic unit (36) in this selected delimited space (10) is determined according to the said second mode of operation (WIWO),

and in that the system is switched, at least temporarily, in this selected delimited space (10), into the said first mode of operation (BIBO) if the information of direction of passage (DIRECTION) determined by the electronic unit (36) is not conclusive.

5. System according to claim 3, configured to pass, at least temporarily, from one mode of operation to another in at least one selected delimited space (10) among the said plurality of delimited spaces, characterized in that the said first low frequency electromagnetic signal (A) comprises selection information (SELECT_BIBO)

5 determined such that, following an entry of an electronic unit (36) into the said selected delimited space (10), the presence or absence of this electronic unit (36) in the said delimited space (10) is determined according to the said first mode of operation (BIBO),

and in that the said second low frequency electromagnetic signal (B) comprises selection information (SELECT_WIWO) determined such that, when an electronic unit
10 (36) leaves the selected delimited space (10), the system is switched at least temporarily into the said second mode of operation (WIWO) in case the system has previously concluded the absence of an electronic unit (36) although this unit is still located in the said selected delimited space (10).

6. System according to any of the preceding claims, characterized in that the
15 said first and/or second low frequency electromagnetic signals (A, B) carry data comprising an indication allowing identification of the said delimited space (10) as well as an indication of the time and the date of the passage of the electronic unit (36) through the said entrance (6).

7. System according to any of the preceding claims, characterized in that the
20 said delimited space (10) is defined by a compartment (32) of a transport vehicle, such as a bus, a railway carriage or a subway train, and in that the said first and/or second low frequency electromagnetic signals (A, B) carry data comprising an indication of the station or the stop where the said transport vehicle is located.

8. Method of detecting an individual (8) or an object in a detection system
25 according to any one of claims 3 to 5, characterized in that each electronic unit (36) further comprises:

- data processing means (44) for processing data provided by the said low frequency reception module (28, 46) and/or data provided by or destined to the said high frequency transmission-reception module (30, 48);
30 - an electrical power supply source (24) for supplying the said processing means (44) as well as the said low frequency reception module (28, 46) and the said high frequency transmission-reception module (30, 48),

in that the said low frequency reception module (28, 46) is supplied permanently or quasi-permanently,

and in that the said data processing means (44) as well as the said high frequency transmission-reception module (30, 48) are deactivated in a so-called standby mode of the said electronic unit (36),

the said data processing means (44) being activated by the said low frequency
5 reception module (28, 46) when this detects one or the other of the said first and second low frequency electromagnetic signals (A, B),

the said high frequency transmission-reception module (30, 48) being activated when the electronic unit (36) has to transmit and/or receive the said high frequency electromagnetic signal (C, ACK),

10 this method comprising the following steps:

a) reception by a card or electronic unit (36) carried by the said individual (8) or object of the said first and/or second low frequency electromagnetic signal (A, B) by means of the said low frequency reception module (28, 46) of the electronic unit (36);

b) activation of the said data processing means (44) of the electronic unit
15 (36);

c) reading the said selection information (SELECT) contained in the first received low frequency electromagnetic signal, namely the said first or second low frequency electromagnetic signal (A, B), and identification of the mode of operation associated with the delimited space (10);

20 d) if the said mode of operation corresponds to the second (WIWO) of the said modes of operation, detection by the said electronic unit (36) of the said direction of passage (DIRECTION) through the entrance (6);

e) activation of the said high frequency transmission-reception module (30, 48) of the electronic unit (36); and

25 f) if the said mode of operation corresponds to the second (WIWO) of the said modes of operation, transmission, after the passage through the said entrance (6), of the said high frequency electromagnetic signal (C) comprising the said information of direction of passage (DIRECTION) by means of the said high frequency transmission-reception module (30, 48),

30 otherwise transmission, at least once, of the said high frequency electromagnetic signal (C) by means of the said high frequency transmission-reception module (30, 48) awaiting a reception acknowledgement (ACK) provided by the said high frequency transmission-reception means (12, 13); and

g) if the said mode of operation corresponds to the second (WIWO) of the

said modes of operation, return of the electronic unit (36) into its standby mode and deactivation of the said data processing means (44) and of the said high frequency transmission-reception module (30, 48), and

if the said mode of operation corresponds to the first (BIBO) of the said modes
5 of operation, return of the electronic unit (36) to its standby mode and deactivation of the said data processing means (44) and of the said high frequency transmission-reception module (30, 48) if no reception acknowledgement (ACK) is received during a predetermined period of time, otherwise repetition of the transmission of the said high frequency electromagnetic signal (C) until no acknowledgement of reception (ACK) is
10 received during the said predetermined period of time.

9. Method of detection according to claim 8, in a detection system according to claim 4, characterized in that, if the said information of direction of passage (DIRECTION) determined by the electronic unit (36) in step d) is not conclusive and it is not possible to determine in an unequivocal manner whether the electronic unit (36) is
15 located inside or outside the said delimited space (10), the said electronic unit (36) is then switched at least temporarily into the said first mode of operation (BIBO).

10. Method of detection according to claim 8, in a detection system according to claim 5, characterized in that, if the said electronic unit (36) is in standby mode and if the first low frequency electromagnetic signal received by the said low frequency
20 reception module (28, 46) in step c) corresponds to the said second low frequency electromagnetic signal (B), the said electronic unit (36) is then switched at least temporarily into the said second mode of operation (WIWO).